

REMARKS

The above-captioned patent application has been carefully reviewed in light of the final Official Action to which this Amendment is responsive. Claims 88, 89, 91-129, 135, 136, 143, 148-150 and 152-154 have been amended and new Claims 159-166 have been added in an effort to further clarify and particularly point out the present invention. To that end, it is believed that no new matter has been entered.

Claims 4, 41-43, 47, 49, 80-82, 84 and 86-158 are pending in this application, wherein Claims 4, 41-43, 47, 49, 80-82, 84 and 86 were previously withdrawn due to a preceding Restriction Requirement. All of the withdrawn claims have been formally canceled, as well as Claims 90 and 130-134.

Claims 87-158 have been rejected on prior art grounds. Claims 87-158 have also been rejected pursuant to 35 USC §112, first paragraph, and Claims 87-129 and 137-145 have further been objected to by the Examiner, based on informalities. Applicant respectfully requests reconsideration based on the new and amended claims, as well as the following discussion.

Applicant gratefully acknowledged the personal interview granted to Applicant's representative, Peter J. Bilinski, by Examiner Lee Fineman on December 6, 2005. The subject matter of the interview is incorporated into this response.

Turning to the prior art rejections, the Examiner has rejected Claims 87-90, 92, 94-96, 130 and 132-134 under 35 USC §103(a) as being unpatentable over Takahashi (U.S. Patent No. 5,522,789) in view of Kawatani (JP 63220217A); Claims 91, 97-99, 101-116, 125-129, 135-147 and 152-158 under 35 USC §103(a) based upon Takahashi and Kawatani and further in view of Sakiyama et al. (U.S. Patent No. 6,063,023); Claims 93 and 131 under 35 USC §103(a) based on Takahashi and Kawatani and further in view of Miyano et al. (U.S. Patent No. 5,040,014); Claims 100, 117-120, 122-124 and 148-151 based upon Takahashi in view of Kawatani and Sakiyama et al. and further in view of Hori et al. (U.S. Patent No. 6,191,809 B1); and Claim 121 under 35 USC §103(a) as being unpatentable over Takahashi in view of Sakiyama et al. and Hori et al. and further in view of Ko (U.S. Patent No. 5,710,428).

Applicant has now canceled independent Claim 87 in favor of new Claim 159. Claim 159 now positively recites a stereo endoscopic system comprising an endoscopic probe, an electronic imaging device and an optical system. Each of the optical system and the electronic imaging device are housed within the probe. The optical system includes a refractive image splitter and at least one focusing lens in which each of the above components, including the electronic imaging device, are disposed along a single optical axis. The at least one focusing lens is disposed between the refractive image splitter and the electronic imaging device wherein the refractive image splitter is used to split a view of the object of interest into two images of the object. According to the invention, the two images are intermixed and carried through the image splitter along the single optical axis to the at least one focusing lens along the single optical axis. More specifically, no optical power is applied or required between the object plane and the at least one focusing lens. The images can then be focused onto the electronic imaging device and displayed as first and second stereo images of the object of interest. Advantageously, this form of optical system is relatively compact and thereby permits the probe to be manufactured to more compact length and diameter. Moreover, it does not require optical elements other than those to steer the images into the focusing lens(es). No power aberrations or effects are caused by the refractive image splitter because the splitter merely uses flat surfaces to direct the images.

Each of the prior art rejections presently made against the claims by the Examiner is based upon Section 103 for obviousness.

In order to make a *prima facie* obviousness rejection under the Statute, each essentially claimed element must be found, or suggested either singly or in combination, in the cited prior art. Those limitations that are not found or suggested by the cited art must be notoriously well known in the prior art as a whole to one of ordinary skill in the field of the invention at the time thereof.

Simply finding all of the elements in various prior art references is not necessarily sufficient to maintain *prima facie* obviousness rejection under the Statute. The purported combination cannot occur through impermissible hindsight (e.g., advance knowledge) of the invention. A motivation to combine references must be found in the prior art as a whole to one of sufficient (e.g., ordinary) skill in

the field of the invention at the time thereof. Piecemeal combination of features in an attempt to re-create the invention after the time of the invention is not a correct use of references. To that end, the references should be read in their entirety. Any combination of references should not destroy or seriously disable the teachings of the references. Such would provide evidence that "teaches away" from the rejection. Moreover, such art should come from analogous fields.

The determination of obviousness is not an easy one. To that end, there are certain indicia (factors) that can be used to support a determination, where proper, of non-obviousness. Among these factors are whether there is a long-felt need in the field of the invention to solve the stated problem.

As noted above, Applicant has devised a stereo endoscopic system that includes a probe housing an electronic imaging device and an optical system. The optical system includes a refractive image splitter and at least one focusing lens wherein the optical system permits a single view of an object of interest to be split into two images by the refractive image splitter. The respective images are intermixed along the single optical axis of the optical system and are steered through the image splitter without application of optical power by the system to the at least one focusing lens, which focuses the stereo images onto the single electronic imaging device. The refractive image splitter, according to one preferred version, is a prism having flat angled surfaces that are used to carry symmetrical images through the image splitter. The surfaces being flat carry the images through the refractive splitter without adding optical power. The latter feature is significant, based upon a critical reading of the cited prior art, particularly the primary reference to Takahashi et al.

As previously discussed, Takahashi (U.S. Patent No. 5,522,789) describes a stereo endoscope for forming right and left images on a single CCD 31 according, for example, to Fig. 13(a). A pair of objective lens (referred to as right and left objective lenses – see col 13, lines 14-15, of this reference) are used to create two images of an object of interest. Several variations are shown and described by this reference, but there is a level of commonality between each of the embodiments that requires discussion. Each embodiment requires certain components. Takahashi is

able to reduce the number of component parts in the stereo optical system by way of certain embodiments. For example, multiple CCDs are used with multiple optical axes in Figs. 9(a) and 11(a), whereas a single tube is utilized in Figs. 10(a) in combination with multiple CCDs and Fig. 13(a), in which the multiple CCDs are replaced by a single CCD. Common to all of the embodiments shown is that effectively parallel optical systems are used with parallel optical axes for directing the images to the focusing lenses. To that end, the embodiment of Fig. 9(a) and Fig. 10(a) are no different other than the vertical compression of the optical systems into a single tube 25. A shielding plate is required to keep the separate images captured by objective lenses 2a and 3b of Fig. 10(a) separate so as have the light behave identically to that of Fig. 9(a) wherein each of the respective objective lenses contain sufficient optical power to axially focus the light through respective relay lenses 4a, 4b. The same characteristics are true in Figs. 10(a) and 13(a), wherein the shielding plate 27 is designed to prevent light leakage and the curvature of the objective lenses 3a, 3b direct the light properly along parallel axial paths so as not to intermix the imager until the images have been relayed to the focusing lens 5.

The shielding plate 27, 27A is necessary, using the system as described “for shielding the objective systems . . . for fear that light will enter the objective optical systems” – see col 10, lines 29-32 as describing the system of Fig. 10(a) wherein the endoscope of Fig. 13(a) “is the same as the endoscope in the third embodiment” (Fig. 10(a)) “except that the CCDs 2a and 2b are replaced with a single CCD 31.” see col 12, lines 65-67. The requirement for the curved objective elements for each entering image and the need for relay lenses creates optical (power) aberrations and also complicate the design of the overall system. In spite of the fact that a single molded objective lens part is shown in Figs. 10(a) and 13(a), it is clear that the light entering the system enters along two distinct parallel axes and not a single optical axis. Takahashi acknowledges this distinction and relates that one goal of the invention is to effectively reduce parallax caused by two parallel images entering his optical system – see col. 3, lines 3-10, 14-20. In spite of the recognition of the problems caused by having parallel images and a recognized need by Takahashi to reduce effects caused thereby, the best solution offered in the primary reference was to compress the system and vertically push the images as close together as possible,

but still maintain the entering images separate until the images have been directed to the focusing lens, as noted using a number optical elements such as relay lenses to perpetuate a parallel axial relationship with no intermixing along a single optical axis.

The secondary cited reference to Kawatani relates to a spectroscopic device and not an imaging device. See Outline of the Invention at Section III of the English language translation of this cited reference. Applicant acknowledges that Kawatani uses a prism to split an incident light beam (not an image) into resulting spectral beams for focusing onto a substrate/detector.

As noted above and in order to maintain an effective obviousness rejection, however, each reference must be read in its entirety. To that end, Kawatani requires a convex lens that is used to insure that the light beam impinging on the prism does so perpendicularly to the surfaces of the prism. Therefore, Kawatani requires the application of optical power on the incident light beam prior to the splitting of same. The present invention, on the other hand, does not require the application of optical power from the object plane to the at least one focusing lens.

In addition to the foregoing, it is believed that there is no teaching in Kawatani of splitting an image into a pair of image parts along a single optical axis. Moreover, there is no suggestion or other apparent teaching that connects this reference to an imaging endoscopic system, particularly a stereo system. In endoscopy, reduction in probe size (diameter, length) is a general pervasive goal in the field. Kawatani provides no impetus regarding solving these problems or for improving or simplifying a stereoscopic endoscope system. Kawatani does not create two images of an object, but rather provides separation of a light beam into two beams that are focused onto the detector.

Takahashi, arguably one of greater than ordinary skill in the field, was aware of the problems caused by contrasting fields of view at the time of his invention. To that end, reference is made throughout Takahashi to a goal of reducing the strain of parallax to the user between the right and left stereo images due in part to differences in field of view – see col. 3, lines 3-10, 14-20. The closest that Takahashi could come was to place the objective lenses as close together as possible in a molded component to reduce the differences in parallel field of views and then to shield the two lenses so as to prevent leakage; that is, thereby maintaining a parallel axial relationship.

It is respectfully submitted that this reference would never have been consulted by one of ordinary skill in the field. The test for non-analogousness that has been adopted by the CAFC involves a two-step inquiry. In the first step, whether a prior art reference is analogous requires a determination of whether the art is from the same field of endeavor regardless of the problem addressed. Clearly, this inquiry must be answered in the negative. The present invention is directed to the field of stereoscopic endoscopes while Kawatani is directed to spectroscopy. It can hardly be argued that these fields are even remotely similar under any reasonable interpretation. The second inquiry requires that if the reference is not within the field of the inventor's endeavor, whether it is still reasonably pertinent to the particular problems with which the inventor is involved.

Applicant believes the second inquiry must also be answered in the negative. Applicant is concerned with the issue of simplifying an endoscope design, for stereoscopic purposes. Kawatani teaches features that are employed at least in part by the invention in that a refractive element is used. However, Kawatani recites the use of such a prism for splitting a light beam and not an image. Moreover, this reference requires the light beam to be specifically (i.e., perpendicularly) aligned relative to the face surfaces of the prism in order to produce beams for contacting the detector substrate through the inclusion of an element that produces optical power. It is not understood how a person of ordinary skill in the field of endoscopy would consult this reference, remove an essential element (a convex lens) and then retrofit same into the system of Takahashi that teaches and describes a twin parallel optical axis system in all of its embodiments wherein images are carried in parallel to a single or dual imagers.

For these reasons, it is believed that the citation of Kawatani is inappropriate and could only have been made with hindsight of the present invention. Though secondary indicia of obviousness are not dispositive they are helpful in determining the state of the art and of "ordinary skill" in the field. Clearly, there is a long felt need demonstrated at least as early as 1993 (the filing date of Takahashi) to attempt to solve the problem that is commonly confronted by Applicants and Takahashi to simplify endoscope designs in stereoscopic versions. Moreover, even if Takahashi or others were not aware of the Kawatani reference, it is not understood why one of ordinary skill would have attempted to implement a single axis design similar to that of Applicant.

Applicant has now added new Claim 159 in an effort to clarify the invention. This claim is directed to a stereo endoscopic system that comprises an endoscopic probe, an electronic imaging device and an optical system wherein each of the optical system and electronic imaging devices are housed within the probe and arranged entirely along a single optical axis. The optical system according to new Claim 159 includes a refractive image splitter and at least one focusing lens disposed between the electronic imaging device and the refractive image splitter. The refractive image splitter directly passes an image of an object of interest to be split along the single optical axis into two images of the object. The two images are guided through the refractive image splitter entirely along the single optical axis to the at least one focusing lens without optical power between the object of interest and the at least one focusing lens. The two images are representative of first and second acquired stereo images of the object of interest that are focused by the at least one focusing lens along the single optical axis onto the electronic imaging device. Support is found for this claim in the above-captioned patent application. See Figs. 1A and 1B. Therefore, it is believed no new matter has been added. Because it is believed Kawatani would not have been combined with Takahashi by one of sufficient skill, absent hindsight, when reading each reference in its entirety, it is believed there can be no *prima facie* obviousness under the Statute. Moreover and even if such a combination were possible, each of Kawatani and Takahashi require application of optical power between an object of interest and at least one focusing lens as opposed to the claimed invention that merely requires the splitting of a single image, wherein the single image and resulting split images are directed or steered without aberrations to the at least one focusing lens. For these reasons, it is believed Claim 159 is therefore considered patentably distinct from this prior art. None of Sakiyama et al., Miyano et al., Hori et al. or Ko are believed to either suggest or recite the features now recited in new Claim 159. As a result, it is believed Claims 88, 89, 91-129 are also allowable for the same reasons. Reconsideration is respectfully requested.

New Claim 161 is a method version of Claim 159, replacing Claim 130 and reciting a method for creating stereo images using an endoscope. This claim now more clearly specifies the step of splitting a view of an object into first and second images using a refractive image splitter for focusing onto a single electronic imager without optical power being applied between an object of interest (e.g., an object

plane) and at least one focusing lens. As noted above and in reviewing Takahashi critically, it is evident that this primary reference was attempting to solve a similar problem as Applicant by reducing the effects of parallax from a parallel field of view. None of the remaining secondary cited references, Ko, Hori et al., Sakiyama et al, or Miyano et al remotely address or suggest any resolution or provide further motivation to make such a combination in spite of an apparent long-felt need in the field. As noted above, it is further believed that Kawatani is non-analogous and would not be applied by a person of ordinary skill in the field of the invention. Regardless, Kawatani requires application of the optical power through use of a convex lens between the beam source and the prism. Claim 161 specifies no optical power between the object plane and the at least one focusing lens. Since each of the prior art, taken either singly or in combination, fails to describe recited features, there can be no obviousness under the Statute. To that end, it is believed new Claim 161 is allowable over the prior art of record, as are dependent Claims 135-158. Reconsideration is respectfully requested.

In passing, Applicant would like to specifically address one other rejection as to dependent Claim 97 and the Examiner's reliance on Sakiyama et al. The Examiner has relied upon col. 8, lines 36-38 in making the argument that Sakiyama discloses the features of this claim. Applicant disagrees with this characterization. Col. 8 of Sakiyama et al. refers to a set of coordinates for correcting geometric distortion based upon the inclusion of a stereo optical adapter. The cited reference teaches coordinate conversion in order to correct the geometric distortion. Figs. 6A and 7A depict views of points (pixels) that have not undergone coordinate correction while Figs. 6B and 7B depict views of pixels that have been corrected. A weight table is used to carry out this correction and an after conversion coordinate is created for each point using the expressions (1) and (2) at col 8. Each of the expressions includes various coefficients. A continued reading of this section indicates that two of the coefficients in calculating coordinate correction are used to "match magnification of two images as well as functions of focal lengths of the lenses". The application of the algorithms, as noted, is specifically to perform a geometric correction based upon parallax due to stereoscopic effects. Nowhere in this reference, however, is there any teaching or suggestion of providing enhanced imaging of portions of at least one stereo image using zooming windows or the like while at the same time permitting the concurrent display of the full images. As

noted in the present disclosure, one reason however, for having such a “zoom” feature is to improve the visibility of an on-screen measurement cursor by permitting the portion of the image having the cursor zoomed to a different magnification and displayed along with the stereo images. This “zooming” window enables better positioning of the measurement cursor relative to the object of interest.

Claim 97 has now been clarified to specify the inclusion of measuring means for comparing parameters of first and second acquired images such that measurement data of the object can be determined, the measuring means including at least one on-screen cursor in which a magnified image of a portion of a displayed image can be displayed concurrently with the image of the object of interest. According to Claim 97, as amended, the magnified image portion contains the on-screen cursor to aid in the positioning thereof. Support is found in the present application, for example, at Fig. 27. No new matter has been added. Reconsideration is respectfully requested.

In addition, new Claims 160, 162 and 163-166 have also been added. Claims 160 and 162 are independent claims directed to a stereo endoscopic imaging/measurement system and a method for positioning an operation on a displayed image, respectively. These claims relate to the use of so-called “zooming” windows to perform to perform enhanced operations based on a displayed image. Most pertinently, these windows can be used in endoscopic or other measurement operations to properly align a measurement cursor, the preceding being a fundamental component of inspection devices, such as those used for identifying a defect of an object, such as an engine, pressure vessel, or other component of interest. It is difficult to properly place the cursor in order for example to conduct a measurement. By magnifying this portion of the image containing the cursor concurrently with at least one of the acquired stereo images, it facilitates the burden on the user considerably and advantageously improves the accuracy and quality of the inspection effort. Claim 166 is dependent on Claim 160 and Claims 163-165 are dependent on new Claim 162, each of the foregoing reciting dependent features thereof with regard to the displaying steps of the claimed system and method. Support for each of the foregoing claims is provided, for example, at page 18, lines 21-31 and Fig. 27 of the above-captioned application. To that end, it is believed no new matter has been added.

With regard to the Section 112 rejection, it is believed that the cancellation of Claims 87 and 130 in favor of new Claims 159 and 161 render this rejection as moot. Withdrawal is respectfully requested.

Finally and as to the claim objections, it is believed Applicant's cancellation of Claim 87 renders the antecedent basis rejection concerning the "single electronic imager" as moot. It is also believed the inclusion of new Claims 159 and 161 renders the objections concerning "the probe" as moot. Claim 103 has been amended as noted by the Examiner in order to cure the antecedent basis problem. Applicants have also amended Claims 88, 89, 91-129 to comport to new Claim 159 and Claims 135-137, 143, 148-150 and 152-154 have been amended to comport to new Claim 161. No new matter has been added.

In summary, it is believed that the above-captioned patent application is now in an allowable condition and such allowance is earnestly solicited.

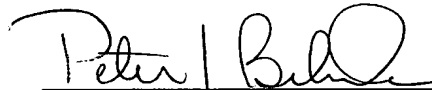
If the Examiner wishes to expedite disposition of the above-captioned patent application, she is invited to contact Applicants representative at the telephone number below.

The Director is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-0289.

Respectfully submitted,

WALL MARJAMA & BILINSKI LLP

By:



Peter J. Bilinski
Reg. No. 35,067

PJB/sca
Telephone: (315) 425-9000

Customer No.: 20874